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Sustainable agriculture as a central science to solve global society issues

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Abstract
Serious global issues such as poverty, illness, food prices, climate changes, global market, pollution, pest adaptation and resistance, soil degradation, decreasing biodiversity and desertification can be explained by the increasing artificialization of human society. Since most issues are now intertwined they cannot be solved anymore by the classical fireman approach. In that respect, the structure of actual science and governmental institutions are probably outdated and should evolve to meet global challenges. Unexpectedly, agronomy appears as a central science to solve current societal issues because agronomists are trained to manage the input of many disciplines such as plant biology, soil science, climate sciences, ecology and chemistry.

Keywords: sustainable agriculture; climate change; biodiversity; agronomy for sustainable development; organic farming; pest control; food; water; soil; pesticide; farming system

Nature does not hurry, yet everything is accomplished.
Lao Tzu

Starving people in poor nations, ill and fat people in rich nations, increasing food prices, climate changes, increasing fuel and transportation costs, flaws of the global market, worldwide pesticide pollution, pest adaptation and resistance, loss of soil fertility and organic carbon, soil erosion, decreasing biodiversity, and desertification are current acute problems that threaten our planet. Most current human issues can be explained by the "artificialisation" of society (Figure 1).

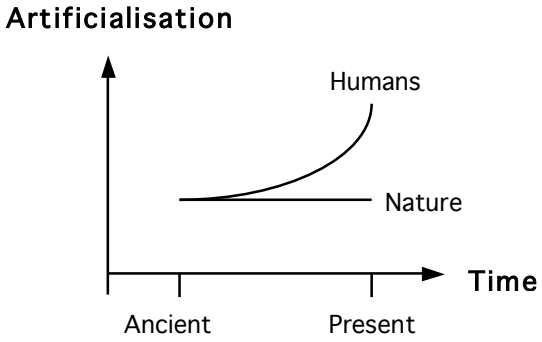

Figure 1. Most current issues of society can be explained by the increasing artificialisation of human behaviour. The artificialisation has started to increase fast during the industrial revolution, leading to global issues.

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Artificialisation began in ancient times with the start of one of the oldest human practice, agriculture. The beginnings of wheat domestication can be traced back at about 8,000 years BC (Araus et al., 2007). At that time, humans switched progressively from a nomad life involving hunting animals and eating wild plants and fruits, typical of animal behaviour, to a more settled life by growing crops, harvesting, and storing food. Tribes rapidly invented money, for instance in the form of shells or salt, as a means to exchange goods with other tribes. That was the beginning of the financial market. Tribes also invented territories and borders. That was the beginning of nations. Early social behaviours had already benefits such as a secure food stock for winter, as well as drawbacks such as wars to conquer wealthier territories. For quite a long time, until the start of the industrial revolution around 1850, negative impacts of society were limited and local because social groups and nations were independent and small. Negative impacts of society were also restricted by time because transport of food, goods, and humans, was slow and mainly local.

Artificialisation increased dramatically during the industrial revolution. The advent of motor boats, cars, and planes allowed rapidly fast transportation of goods over long-distances. Social groups and nations began to be less and less independent, and thus relied on other countries for food and goods. This worldwide behaviour led to tremendous benefits such as medicine that has highly increased the human lifetime. But this led also to worldwide negative consequences such as world wars I and II, Chernobyl, and, more recently, climate change, poorer countries and ill-fat wealthy people.

Society issues have so far been solved using mainly the "fireman" approach, or the "pain-killer" approach as a more medical version, by which an individual problem is solved by an individual solution. A such approach does not work anymore on two grounds, at least. First, all systems, mechanisms, and activities are closely intertwined. For instance food production is closely linked to health, climate change, transportation, market, finance, and politics. Thus applying a remedy to only one element of this system will not work because the remedy will induce negative impacts on other elements in the end. Only solutions that consider the whole system and its connections will have a chance to succeed now. Second, the fireman approach does not treat the source of the problem. It only treats the negative consequence. Here, an obvious solution is to identify the problem sources, and to anticipate potential future problems.

From those observations, two advices can be given. First, actual borders, names, and field covered that separate government institutions are probably outdated. For example an agriculture department should not be separated from health, economics and transportation departments because most agriculture issues are linked to health, economics and transportation. The name, structure, mechanisms and field covered by departments should thus evolve to take into account the sources and connections of modern issues. Second, in a similar way, the division of sciences into disciplines such as physics, biology, and chemistry is not in line with actual scientific issues that are solved by an input of several disciplines. The names, structures, mechanisms, and field covered by scientific disciplines should thus evolve to adapt to actual, interconnected scientific issues.

For a long-time Agronomy has been considered as a soft, side science because food production was not really an issue in rich nations since the start of industrial farming around 1960. Now, unexpectedly, agronomists appear as the best scientists to solve current societal issues of food, climate change, health, and poverty. Indeed, agronomists are typically used to solve issues that need the input of many sciences such as plant biology, soil science, climate sciences, environmental chemistry (Lichtfouse et al., 2005), geology, sociology and economics (Lichtfouse et al., 2004, 2009a). They are also used to work on very complex research objects, the behaviour of which being seldom reproducible. Sustainable agriculture thus appears as a central science. Sustainable agriculture is thus the best fitted science to solve current issues, to anticipate future negative impacts, and to define novel practices that will make the world safer for our children. Detailed agroecological practices are published in the book Sustainable Agriculture (Lichtfouse et al., 2009b).

This is the introductory article of volume 1 of the book series Sustainable Agriculture Reviews. I report next essays on society issues in volume 2 and 3 (Lichtfouse, 2009a,b). Volume titles of Sustainable Agriculture Reviews are:

1. Organic farming, pest control and remediation of soil pollutants.
ISBN: 978-1-4020-9653-2. DOI: 10.1007/978-1-4020-9654-9

2. Climate change, intercropping, pest control and beneficial microorganisms.
ISBN: 978-90-481-2715-3. DOI: 10.1007/978-90-481-2716-0

3. Sociology, organic farming, climate change and soil science.
ISBN: 978-90-481-3332-1. In press.

4. Genetic engineering, biofertilisation, soil quality and organic farming.
ISBN: 978-90-481-8740-9. In press.

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